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ABSTRACT

Four selected scales from the Learning Environment Inventory (LEI) were rewritten to measure the students' individual perceptions of their classroom environment, rather than their estimates of the opinions of the class as a whole. Both scales were then administered to 10 7th grade math classes and 4 10th grade social studies classes. The rewritten scales showed increased alpha reliabilities but no consistent decrease in the standard error of measurement. Discrimination between classes was poorer with the rewritten scales, but correlations with student achievement at the individual level were generally larger. Responses of 10th graders showed greater internal consistency than those of 7th graders, but did not produce more reliable discrimination between classes. (Author)

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CHANGING THE FOCUS OF RESPONSE IN ASSESSING CLASSROOM LEARNING ENVIRONMENTS

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INTRODUCTORY STATEMENT

The Center for Social Organization of Schools has two primary objectives: to develop a scientific knowledge of how schools affect their students, and to use this knowledge to develop better school practices and organization.

The Center works through five programs to achieve its objectives. The Academic Games program has developed simulation games for use in the classroom. It is evaluating the effects of games on student learning and studying how games can improve interpersonal relations in the schools. The Social Accounts program is examining how a student's education affects his actual occupational attainment, and how education results in different vocational outcomes for blacks and whites. The Schools and Maturity program is studying the effects of educational experience on a wide range of human talents, competencies, and personal dispositions in order to formulate -- and research -- important educational goals other than traditional academic achievement. The School Organization program is currently concerned with authority-control structures, task structures, reward systems, and peer group processes in schools. The Careers and Curricula program bases its work upon a theory of career development. It has developed a self-administered vocational guidance device and self-directed career program to promote vocational development and to foster satisfying curricular decisions for high school, college, and adult populations.

This report was a cooperative project of the Academic Games and the School Organization programs. It examines a version of the Learning Environment Inventory (LEI), containing items recasted in a first-person format, in order to determine its relevance for testing individual environment-behavior relationships.

ABSTRACT

Four selected scales from the Learning Environment Inventory (LEI) were rewritten to measure the students' individual perceptions of their classroom environment, rather than their estimates of the opinions of the class as a whole. Both scales were then administered to ten seventh-grade math classes and four tenth-grade social studies classes. The rewritten scales showed increased alpha reliabilities but no consistent decrease in the standard error of measurement. Discrimination between classes was poorer with the rewritten scales, but correlations with student achievement at the individual level were generally larger. Responses of tenth-graders showed greater internal consistency than those of seventh-graders, but did not produce more reliable discrimination between classes.

INTRODUCTION

A major thrust of social psychological inquiry in education has been to examine the effects of person-environment interactions on the learning of individuals (Charters, 1973). Instructional climate of the classroom is one aspect of person-environment interactions which has received considerable attention in recent years. The most extensive research on classroom climate to date has employed the Learning Environment Inventory--LEI (Anderson, 1970b), a questionnaire designed to measure several characteristics of the classroom as a social environment for learning, as perceived by the students.

The LEI contains 105 statements describing the classroom environment, and the student respondent indicates his agreement or disagreement with each statement, relative to the class he is in, on a four point scale (ranging from "strongly disagree" to "strongly agree"). As described by Anderson (1970), the LEI contains fifteen scales which include, among others, competitiveness, satisfaction, difficulty, friction, and cohesiveness. Classroom estimates of each scale are obtained by computing the average, a mean response of the respondents in the classroom.

A number of interesting findings have emerged from the LEI research. Anderson, Walberg, and Welch (1969) reported that different curriculum materials produced systematic differences in LEI scores. Anderson (1970a) reported that certain LEI variables acted as moderators of the relationship between students' IQ and their achievement in physics. And Walberg and Ahlgren (1970) reported that class mean scores on several LEI scales could be predicted from several types of antecedent variables, including students'

biographical information, pre-test scores, and personality scales. In another study, Anderson (1971) found that the mean scores of high school classes on LEI scales were systematically related to course content (i.e., subject area: science, mathematics, humanities, or foreign language), but not to sex of teacher. Walberg, Sorenson, and Fischbach (1972), using four of the LEI scales in a study of fifth-grade classes, found that the LEI variables were systematically related to the sex composition and socio-economic status composition of the class. And DeVries and Edwards (1972) found that different combinations of class activities and reward structures in seventh-grade mathematics classes produced systematic differences on four selected LEI scales.

The Problem

There are, however, several problems with measures of the learning environment, such as the LEI, which limit their usefulness for educational research. First, the LEI is based on social psychological concepts of groups which do not hold up in the classroom. Second, the LEI allows analyses of both causes and effects of learning environments at only the group level thereby excluding all considerations of individual difference across students and trait-treatment interactions. Third, the LEI demands high inference judgments from the students which often results in less than satisfactory reliability estimates for the scale. The present paper examines these problems in greater detail and proposes and tests an alternative form of the LEI.

Classes as groups: The LEI is based on the Group Dimensions Description Questionnaire, developed by Hemphill (1956), and validated by use with a large number of functioning adult groups. These groups included a B-17 aircrew, a church choir, and a military band. The vast majority of these groups met two requirements often cited (Steiner, 1972) as essential elements of groups, namely a positive or promotive interdependence among members in both activities and rewards. That is, the group members share both activities and rewards. For such groups, it is eminently sensible to take estimates of group processes and climate and relate such estimates to measures of group outcomes, such as productivity. Students in the same classroom, in contrast, typically represent little more than a cohort of co-acting (vs. cooperating) individuals who are only peripherally related on task or reward dimensions. Perhaps a class of students should not be viewed as a group in the traditional sense, i.e., with an aggregate of interacting individuals collectively generating outcomes, but rather as a setting for multiple social contexts which exert effects on individual students.

Individual differences among students. As noted recently by Berliner and Cahen (1973), individual differences among students, particularly in their reactions to alternative instructional techniques, has always been a major focus of educational research. Rarely does an instructional technique have similar effects across all types of students. However, the LEI, both as conceptualized and empirically used, assesses uniquely group properties. For example, students' affective responses to the instructional techniques used in a classroom are measured by the average student response to such items as "The students enjoy their work."

The inappropriateness of the LEI as a measure of an individual student's idiosyncratic perception of the social climates surrounding him is evidenced by recent data cited in Anderson (1973). In a review of studies correlating LEI climate scores with student learning, Anderson has noted that consistently significant results are obtained only when classroom aggregate measures (i.e., means) are used. In the one study relating individual student LEI scores to individual learning few significant correlations were observed (Walberg and Anderson, 1968). Anderson concluded that the success in research using classroom climate measures and the lack of success using individual measures of climate suggests that measures of learning climate are essentially group characteristics.

Anderson's conclusion should be questioned for the following two reasons. First, Shaycroft (1963) has shown that correlations between variables based on classroom means are larger than correlations based on individuals primarily because such means are more reliable. Consequently, the LEI classroom means were better predictors not because group means are more salient, but rather more reliable. In addition, the treatment of individual LEI scores as measures of an individual student's phenomenological reaction to his social climate is methodologically faulty. The LEI does not ask the student how he behaves in or feels about the classroom, but rather asks him to estimate his classmates' reactions. In short, the LEI, as presently constituted, is appropriate for answering questions about the educational effectiveness of alternative educational methods at the group, but not the individual level. Such a limitation places a major restriction on the usefulness of the LEI for evaluative research.

High Inference Judgments: Anderson (1973), in his review of the LEI, points out the "high-inference" nature of the judgments required from the respondent. By this he means the ratings are subjective perceptions and focus on broad behavioral and/or affective states, such as "competition," or "sense of satisfaction." However, Anderson fails to note an even more important inference required by the respondent, namely how the other students behave, think, and feel. For example, one item from the "difficulty" scale asks the students to assess whether "students in the class tend to find the work hard to do." Making such a judgment is a difficult cognitive task and may involve two stages. First, the respondent must assess the perceptions of all of his classmates, perhaps determining the distribution of perceptions across his classmates. Second, he is required to eventually average his classmates' individual reactions in order to arrive at a single estimate. In their own previous work with the LEI, the authors have noted frequent examples of students becoming confused when they are asked to make such judgments. The difficult judgments required of the respondent may explain in part the relatively low degree of consistency in responses both across items and over time, as reported by Anderson (1973). (The average scale coefficient alpha = .72; average scale test-retest = .61.) Clearly, an estimate of the social climates in the classroom requiring less cognitively complex judgments by the respondents is desired.

A Modification of the LEI: The present paper proposes a modification of the LEI which deals with the above mentioned problems by (1) allowing the student to select his own subset of classmates as referents in describing the social climates surrounding him, (2) permitting analyses of instructional climates at both the individual and class levels of aggregation, and (3) asking

the respondent to describe his, and only his behavior, thoughts, or feelings concerning activities in the classroom. Operationally, the modification of the LEI involves recasting the LEI items in the first-person format.

In order to assess the usefulness of the proposed first-person estimate of instructional climate, the reliability and validity of the first-person LEI format are assessed, relative to the traditional third-person LEI format. More specifically, the two forms were examined as to their (1) internal consistency properties, (2) estimates of the classroom learning environments, and (3) relationship to measures of learning outcomes. Although the revised format deals with the three above mentioned difficulties with the LEI, it is important to also assess its various measurement properties.

METHOD

Subjects

The subjects were drawn from two distinct student populations. The first sample consisted of 299 students in ten seventh-grade mathematics classes at a junior high school in Baltimore, Five of these classes were taught by one teacher and five by another; both teachers were women in their mid-20's with three or four years of teaching experience. The second sample consisted of 137 students in four social studies classes at a Florida high school. Two of these classes were team-taught by two teachers; the other two were considerably smaller and were taught by a third teacher. All three teachers were women in their 40's with several years of teaching experience.

LEI Questionnaire

The questionnaire for the study contained only the twenty LEI items to be investigated--four scales of five items each. The scales selected from the LEI were those entitled "Satisfaction," "Difficulty," "Competition," and "Cohesiveness." These particular scales were selected because of their relevance to other research done by the authors (see DeVries and Edwards, 1972). The first two scales have the academic task as the referent, whereas the second two refer to interpersonal behavior. The five items selected for each scale from the original seven were chosen on the basis of their adaptability to a first-person presentation. The actual rewording of the items was accomplished by taking each item and changing it to refer to the individual respondent, rather than the class as a whole. For example, "The students enjoy their class work " became "I enjoy my class work." Table 1 presents all the items on each scale in both their original (third-person)

and reworded (first-person) versions. The response options on the questionnaire were "Strongly Disagree," "Disagree," "Agree," and "Strongly Agree." These options were scored 1, 2, 3, 4 for items that were positively worded (in terms of the title of the scale) and 4, 3, 2, 1 for negatively worded items.

Two versions of the questionnaire were produced, one consisting of third-person items (original LEI form) and the other consisting of first-person items. The questionnaires were then arranged in alternating sequence, to insure that within each class the same number of students (plus or minus one) would answer each type of questionnaire. The questionnaires were administered by the experimenters, except in one case when two classes met at the same time and only one experimenter was present; in this case the classroom teacher administered the questionnaire to one of the classes. The procedure resulted in a fifty percent sampling of the class for each version of the questionnaire. Anderson (1970) has indicated that such a sample is adequate to reliably estimate the classroom mean.

Measures of Student Learning

Achievement scores were obtained on the Computations subtest of the Stanford Achievement Test (SAT) in mathematics and on a test designed to tap divergent production skills (Edwards, et al., 1972) in five of the seventh-grade classes. The SAT Computations subtest yielded a grade equivalent score based on national norms and the divergent solutions test provided two subtest scores which were the number of correct responses. These data were used to investigate the correlation of the LEI scales with achievement at the individual student level for both formats.

Analyses

Reliabilities of the scales at the student level were examined by computing coefficient alpha (Cronbach, 1951) and using it, in turn, to estimate the standard error of measurement. The reliabilities of classroom means were examined by computing the intraclass correlation coefficient (Ebel, 1951). In addition, the 20 x 20 correlation matrix of inter-item correlations was factor-analyzed using Harman's (1967) MINRES technique. The four-factor solutions of the first and third-person formats were compared in terms of item communalities and the amount of common variance extracted. Classroom means on each of the scales for the two item formats were compared using analysis-of-variance procedures.

RESULTS

Reliability

The alpha reliabilities of each scale in the third-person and first-person versions in the two samples of students are shown in Table 2. In seven out of eight comparisons the alpha coefficient for the first-person version is higher, indicating greater reliability at the individual level. This result -- seven out of eight comparisons in the predicted direction -- has probability .035 of occurrence under the null hypothesis of no real difference (Sign Test, Siegel, 1956). The alpha reliabilities are also higher -- without exception -- in the tenth-grade sample than in the seventh-grade sample.

To find out whether the increase in alpha reliabilities represents increased precision of measurement, rather than just an increase in the true variance of the variables being measured, it is necessary to look at the standard error of measurement for each version within each sample. This information is presented in Table 3. For the seventh-graders, the first-person scales consistently show a substantially smaller standard error of measurement than the third-person scales, indicating greater precision. For the tenth-graders, the effect seems to be in the reverse direction, at least for the satisfaction and difficulty scales and possibly also for the competition scale. The probability of five out of eight comparisons in the predicted direction is .363 under the null hypothesis. Comparison between samples indicates that measurement is more precise in the tenth-grade sample for both versions of all four scales.

Although the present study focuses on the individual scores, the reliability of classroom means was also examined using the intraclass correlation coefficients. These are presented in Table 4. The intraclass correlation coefficient is computed by the formula $(V_p - V_e)/V_p$, where V_p is the variance among objects being rated and V_e is the error variance. For discriminating between classes, the V_p term is the mean square between classes; V_e is the mean square within classes (Ebel, 1951).

The large number of zeroes in Table 4 is due to the relatively small number of classes included in the study and the fact that classes were rather homogeneous within grade level. However, the results do give some indication of the relative discrimination power, at the classroom level, for the original and rewritten LEI scales. For the seventh-grade classes, the first-person items were substantially better on satisfaction and slightly better on cohesiveness for discriminating between classes. In three of the four comparisons for tenth-grade classes, the third-person items discriminated better than first-person items. A systematic comparison of the two scale types at the classroom level would require a much larger sample of heterogeneous classes.

Factor Structure

Four-factor MINRES factor analyses of the first-and third-person items at each grade level yielded solutions that were quite similar. In terms of item communalities across the four factors, thirteen of twenty communalities increased from third to first-person for the seventh grade sample ($p = .13$, sign test) and fourteen of twenty increased from third to first-person for

the tenth-grade sample ($p = .06$, sign test). These results are reflected in the percent of variance extracted by the four-factor solutions. In the seventh-grade sample, the four factors accounted for 45.6% and 38.7% of the total variance of the first-and third-person items, respectively. In the tenth-grade sample, the figures were 59.5% and 53.5% for the first- and third-person items respectively.

Estimates of Class Environments

The foregoing analyses concentrated on the effects of the change in items on the reliability of the scales. Another important consideration is whether the change in item types results in any systematic differences in classroom means. Analyses of variance (ANOVA) were performed comparing the mean scale scores for the first- and third-person items within each sample; teachers and classes-within-teachers were included as factors in the ANOVA to test for possible interactions with item type. Since none of the possible interactions were significant, the full ANOVA tables are not presented. Table 5 shows the mean scale score by item type in both the seventh- and tenth-grade samples. In the seventh-grade sample, the difference between means for the two item types had very low probabilities of occurrence under the null hypothesis for three of the four scales. Students answering the first-person items reported greater satisfaction, less difficulty, and less competition than their classmates who answered the third-person items. For the tenth-grade sample, the differences on two of the four scales had low probabilities of occurrence under the null. Again, students answering the first-person items reported greater satisfaction and less difficulty. On each of the four scales, the differences between means observed in the tenth- and seventh-grade samples for the two item types were in the same direction.

Prediction of Student Learning

Another point of interest in the present study was the correlations between students' LEI responses and their class achievement scores. As noted in the introduction, a study of the relationship between perceived instructional climate and individual achievement would require individually oriented measures on both dimensions. In this regard, the third-person LEI format is inappropriate.

Data on class achievement was available for half of the seventh grade sample (n = 120). Correlations among the grade-equivalent scores on the Stanford Achievement Test in Math Computation, the two divergent solutions subtests, and the four LEI scales were calculated separately for the first-person and third-person formats. The results are given in Table 6. Two of the differences -- between first-/and third-person correlations -- those involving LEI satisfaction and Divergent Solution I, and LEI competition and Divergent Solution II -- would be significant at the .05 level if considered individually. However, in a set of twelve independent significance tests at the .05 level, the probability of observing at least one significant difference with random data is .46. Thus, the results give only weak support to the contention that first-person items are more appropriate for analyses at the individual level. However, for the first-person format, two of the four correlations between LEI and the SAT are significant, whereas none of the third-person correlations are significant. Similarly, two of the eight correlations between LEI and the divergent solutions subtests are significant for the first-person format, and only one of the corresponding correlations for the third-person format is significant. The fact that the largest differences in correlation are primarily on the task referent LEI scales of satisfaction and difficulty, where the first-person format is clearly more appropriate, does support our hypothesis.

DISCUSSION

The purpose of the present study was to develop an alternative measure (to the LEI) of social climates in the classroom which would (1) be free of the conceptual ambiguities of the LEI, and (2) which has reasonable measurement properties. In general, the expectations of the study were realized. The first-person form of the LEI exhibited adequate internal consistency, yielded a factor structure highly similar to the original LEI, and predicted individual student achivement.

When comparing the relative internal consistency of the first-person vs. third-person (or original version) LEI forms, the first-person LEI had higher consistency, and thus contained more common factor variance than the original. However, increases in reliability were not always accompanied by decreases in the standard error of measurement. Such a result indicates that the reliability increase was largely the result of an increase in the true variance of the variables measured, because as true variation among subjects increases, the precision of measurement required to distinguish reliably among them decreases. The fact that the scales on the rewritten version correlated more highly with achievement measures than those on the original version is in part attributable to this increase in true score variation.

Increasing the reliability and validity of LEI environment measures at the individual level by changing the focus of response also affects the estimates of these variables at the classroom level. However, the desirability

or importance of such changes is not clear. The reliability of classroom means as estimated by the intraclass correlation was generally lower when the focus of response was the individual respondent. This was primarily due to an increase in within-class variation which is treated as error variance in the intraclass correlation formula. In all of the studies to date using LEI data at the classroom level, the mean was the only statistic used as a variable in the analysis. Thus, changes in within-classroom variations alone would not be important. However, if one were to employ the multivariate model advocated by Lohnes (1972), changes in variance as a function of instrumentation would be an important consideration.

The analyses by grade suggested that the highly cognitive judgments demanded by the original LEI format are particularly difficult for the seventh-grade students. The first-person format resulted in greater improvements in internal consistency and factor structure primarily for the seventh-grade sample. It may be unrealistic to ask younger children to make inferences about students attitudes and behavior at the classroom level. Age may, not, however, be the only factor which creates difficulty in assessing classmates' behaviors and/or cognitive beliefs. The length of time the class has met, and the degree of social and task interaction that takes place among the students are also potentially important factors in determining the difficulty students have in rating the classroom social climate.

Finally, the higher correlations of the first-person format with achievement indicate greater validity at the individual level. It is clear both logically and empirically that the focus of response for environment

measures should be the individual student when the individual is the unit of analysis. However, when subgroups such as classrooms are being analyzed as units, the problem of which format to use is not easily resolved. It may be that simply aggregating individual data to estimate group characteristics is neither desirable nor appropriate. The two approaches may require different measurement strategies. The present study was not designed to compare the two formats at the group level. The results do suggest that the issue needs to be investigated in more detail before results from instructional environment research can be interpreted meaningfully.

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Table 1
LEI Items in Third-Person and First-Person Versions

	SATISFACTION SCALE:	
1.	The students enjoy their class work.	I enjoy my class work.
2.	Almost all the students like the class.	I like the class.
3.	Many students do <u>not</u> like much that the class does.	I do <u>not</u> like much that the class does.
4.	The students in the class look forward to coming to class meetings.	I look forward to coming to class meetings.
5.	After the class, the students have a sense of satisfaction.	After the class, I have a sense of satisfaction.
	DIFFICULTY SCALE:	
6.	Students have to work hard in this class.	I have to work hard in this class.
7.	Students in the class tend to find the work hard to do.	I tend to find the work in this class hard to do.
8.	The way the teacher teaches is too simple for many students.	The way the teacher teaches is too simple for me.
9.	Most students consider the class work easy.	I consider the class work easy.
10.	Many students in the school would have trouble doing the advanced work of this class.	I have trouble doing the advanced work of this class.
	COMPETITION SCALE:	
11.	Most students want their work to be better than their friends' work.	I want my work to be better than my friends' work.
12.	Students compete to see who can do the best work.	I compete with other students to see who can do the best work.
13.	A few of the class members always try to do better than the others.	I always try to do better than the other class members.
14.	Students feel left out unless they compete with their classmates.	I feel left out unless I compete with my classmates.
15.	Students <u>seldom</u> compete with one another.	I <u>seldom</u> compete with other students.
	COHESIVENESS SCALE:	
16.	Members of the class do favors for one another.	I do favors for other members of the class.
17.	A student has the chance to get to know the other students in the class.	I have had the chance to get to know the other students in the class.
18.	Students are <u>not</u> together enough to like or dislike one another.	I am <u>not</u> with my classmates enough to like or dislike them.
19.	The students in the class do <u>not</u> know each other well.	I do <u>not</u> know the other students in the class well.
20.	Each student knows the other members of the class by their first names.	I know the other members of the class by their first names.

Table 2

LEI Alpha Reliabilities for Third-Person and First-Person Forms

LEI SCALE	SEVENTH GRADE 3rd Person	1st Person	Change[1]	TENTH GRADE 3rd Person	1st Person	Change
Satisfaction	.57	.65	+	.79	.83	+
Difficulty	.36	.63	+	.78	.73	-
Competition	.49	.63	+	.72	.80	+
Cohesiveness	.39	.56	+	.60	.80	+

[1]NOTE - Seven of the eight alpha coefficients changed in the predicted direction; p = .035 using the Sign Test.

Table 3

LEI Standard Errors of Measurement for Third-Person and First-Person Forms[1]

LEI SCALE	SEVENTH GRADE 3rd Person	1st Person		TENTH GRADE 3rd Person	1st Person	
Satisfaction	1.53	1.37	+	1.06	1.20	-
Difficulty	1.71	1.48	+	1.09	1.21	-
Competition	1.76	1.63	+	1.25	1.31	-
Cohesiveness	1.74	1.47	+	1.39	1.16	+

[1]NOTE - Standard Error of Measurement = $\sigma_x \sqrt{1 - r_{xx}^2}$, where r_{xx} is the reliability coefficient estimated by coefficient alpha.
Five out of eight SEMs decreased from 3rd to 1st Person;
p = .363 using the Sign Test.

Table 4

LEI Intraclass Correlations for Third-Person and First-Person Forms

LEI SCALE	SEVENTH GRADE		TENTH GRADE	
	3rd Person	1st Person	3rd Person	1st Person
Satisfaction	.39	.85	<.00	<.00
Difficulty	.61	<.00	.32	<.00
Competition	<.00	<.00	.45	<.00
Cohesiveness	.41	.43	.56	<.00

Table 5

Means for Third-Person and First-Person LEI Forms

	Satisfaction	Difficulty	Competition	Cohesiveness
TENTH GRADE				
First-Person	12.88	13.95	12.71	13.77
Third-Person	11.35	14.40	12.88	13.52
Differences	+ 1.53	- 0.45	- 0.17	+ 0.25
Probability	p = .017	p = .099	p = .798	p = .718
SEVENTH GRADE				
First-Person	14.08	12.27	12.12	15.01
Third-Person	12.80	13.10	13.25	14.81
Differences	+ 1.28	- 0.83	- 1.13	+ 0.20
Probability	p = .004	p = .051	p = .001	p = .552

Table 6

Correlations of both Third-Person and First-Person LEI Scale Scores With Achievement Test Scores

LEI SCALES	Stanford Achievement Test - Computations	Divergent Solutions I	Divergent Solutions II
Satisfaction			
First-Person	.312*	.274*	.040
Third-Person	.187	-.153	.152
Difficulty			
First-Person	-.319*	-.265*	-.205
Third-Person	-.069	-.158	-.147
Competition			
First-Person	.099	.150	.114
Third-Person	-.062	-.135	-.272*
Cohesiveness			
First-Person	-.101	.107	-.006
Third-Person	-.187	.060	.146

$n_{First} = 57$ $n_{Third} = 63$

* $p < .05$ two-tailed test